**3GPP TSG-RAN WG4 Meeting # 107 R4-230xxxx**

**Incheon, KR, May 22nd – May 26th , 2023**

**Agenda item:** 11.3

**Source:** Moderator (China Telecom)

**Title:** Email discussion summary for [107][155] RAN\_task\_UERF

**Document for:** Information

# Introduction

This discussion summary will cover two agendas:

11.1 RedCap HPUE

11.2 RAN4 specification impact and UE implementation impact for a UE configured with two serving cells, each with SUL

According to the contributions submitted, this discussion summary will focus on the following topics:

* Topic#1: [11.1] RedCap HPUE
  + Sub-topic 1-1: RedCap HPUE A-MPR
  + Sub-topic 1-2: RedCap HPUE RSD
  + Sub-topic 1-3: RedCap HPUE form factor
* Topic#2: [11.2] RAN4 specification impact and UE implementation impact for a UE configured with two serving cells, each with SUL.
  + Sub-topic 2-1 assess specification and UE implementation impacts to support back-to-back transmissions between two SUL carriers and between SUL carrier and non-corresponding NUL carrier under the UL Tx switching framework.
  + Sub-topic 2-2 assess specification and UE implementation impacts for back-to-back transmissions between two SUL carriers and between SUL carrier and non-corresponding NUL carrier with 0us switching period.

Note that the tables for collecting comments for sub-topic issues are arranged just below the corresponding sub-topic/issue.

# Topic #1: [11.1] RedCap HPUE

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Proposals / Observations/Abstracts** | **Company** |
| R4-2307257 | ***Proposal 1:*** *For FD-FDD, considering that non-Redcap PC2 UE is implemented with 1 or 2 Tx chains and Redcap PC2 UE is implemented with 1 chain, RAN4 to check whether the A-MPR for non-Redcap PC2 UE can be directly re-used for Redcap PC2 UE on the same band.*  ***Proposal 2:*** *For FD-FDD,* *RAN4 to discuss the RSD for 2Rx and 1Rx RedCap UE respectively. More specifically,*   * *Check whether the RSD for non-RedCap 2Rx PC2 UE can be re-used for RedCap PC2 2Rx UE.* * *Discuss whether the single Rx antenna port RSD allowance for RedCap PC3 UE can be re-used for RedCap PC2 UE.*   ***Proposal 3:*** *RAN4 to first confirm the feasibility of PC2 RedCap for sensor and camera.*  ***Proposal 4:*** *Further discuss whether the UE power consumption* *and overheating issues would prevent wearable UE to support PC2 RedCap.* | China Telecom |
| R4-2307586 | **Proposal 1: Do not restrict the PC2 support for different form factor of RedCap UE.**  **Proposal 2: Use CR to enable PC2 for RedCap in a generic manner in TEI17** | CMCC |
| R4-2308224 | **Proposal 1: Not restrict the applicable form factor for PC2 RedCap HPUE in the specification.**  **Proposal 2: The requirements of FDD PC2 HPUE for handheld UE are applicable for PC2 RedCap HPUE (2Rx) in band agnostic way.**  **Observation 1: For 1Rx RedCap PC2 UE, some Rx requirements degradation would be expected due to smaller number of Rx chains.** | China Unicom |
| R4-2308258 | **Observation 1: 3dB antenna loss is only assumed for RedCap wearable devices.**  **Observation 2: Even with the antenna efficiency loss, lower cell edge target data rate can be acceptable for wearables (e.g. smart watch) compared with smart phones (1Mbps cell edge target data rate assumed in RAN1 studies).**  **Observation 3: The justification on UL coverage issue for RedCap UEs is not clear to the group.**  **Observation 4: For sensor and camera form factor, there is no 3dB antenna loss assumption.**  **Observation 5: The OTA test method for NR RedCap TRP measurement is under development in Rel-18 TRP TRS WI.**  **Proposal 1: Following RAN guidance, RAN4 should focus on the applicable form factor on sensor and camera.**  **Proposal 2: The restriction on the applicable form factor for PC2 Redcap should be reflected in the CR directly, or in the new WID.** | vivo |
| R4-2308825 | ***Observation 1. Several (Not all) FDD bands support PC2 which are included in HPUE\_NR\_FR1\_FDD\_R18 basket WID.***  ***Observation 2. Band agnostic way can also be applied for PC2 FD-FDD RedCap UE in the case of the supported operating bands for PC2 FD-FDD RedCap are the same with PC2 FDD non-RedCap bands. Otherwise, band agnostic way cannot be applied, and A-MPR/RSD requirements should be discussed.***  ***Proposal 1. Not restrict the applicable form factor for PC2 RedCap HPUE in the specification.***  ***Proposal 2. By applying same PC2 FDD non-RedCap bands for PC2 FD-FDD RedCap UE, band agnostic way can be applied for PC2 FD-FDD RedCap.*** | ZTE Corporation |
| R4-2309269 | **Observation 1: Both A-MPR and RSD are operating band specific.**  **Observation 2: Band specific work could be avoided by giving sufficient A-MPR and RSD allowance to the UE.**  **Observation 3: Re-using RSD from regular NR UE may not be possible as RedCap UE may not have diversity Rx and may suffer from worse RSD.**  **Observation 4: Re-using A-MPR from regular NR UE would require the regular NR UE A-MPR be based on single Tx or be at least as much as single Tx A-MPR**  **Observation 5: Even if fully band agnostic approach is not possible, there are possibilities to leverage the analysis done for regular NR UE in case-by-case manner.** | Qualcomm Inc. |

## Open issues summary

### Sub-topic 1-1: RedCap HPUE A-MPR

Sub-topic description:

**Issue 1-1-1: A-MPR for FD-FDD RedCap PC2 UE**

* Proposals
  + Option 1: A-MPR for Redcap PC2 UE needs to be revisited at least for single Tx chain case
  + Option 2: A-MPR for non-Redcap PC2 UE can be directly re-used for Redcap PC2 UE
* Recommended WF
  + TBA

### Sub-topic 1-2: RedCap HPUE RSD

**Issue 1-2-1: RSD for FD-FDD RedCap PC2 2Rx UE**

* Proposals
  + Option 1: RSD for RedCap PC2 2Rx UE needs to be revisited
  + Option 2: RSD for non-RedCap 2Rx PC2 UE can be re-used for RedCap PC2 2Rx UE
* Recommended WF
  + TBA

**Issue 1-2-2: RSD for FD-FDD RedCap PC2 1Rx UE**

* Proposals
  + Option 1: RSD for RedCap PC2 1Rx UE needs to be revisited
  + Option 2: Single Rx antenna port RSD allowance for RedCap PC3 UE can be re-used for RedCap PC2 UE
* Recommended WF
  + TBA

### Sub-topic 1-3: RedCap HPUE form factor

**Issue 1-3-1: RedCap PC2 UE for sensor and camera**

* Proposals
  + Option 1: RedCap PC2 UE is feasible for sensor and camera
  + Option 2: RedCap PC2 UE is feasible without restriction of form factor
* Recommended WF
  + Option 1

**Issue 1-3-2: Issues that prevent wearable UE to support PC2 RedCap.**

* Issues
  + Observation 1: UE power consumption
  + Observation 2: UE overheating
  + Observation 3: 3dB antenna loss is only assumed for RedCap wearable devices.
  + Observation 4: Even with the antenna efficiency loss, lower cell edge target data rate can be acceptable for wearables (e.g. smart watch) compared with smart phones (1Mbps cell edge target data rate assumed in RAN1 studies).
  + Observation 5: The justification on UL coverage issue for RedCap UEs is not clear to the group.
* Recommended WF
  + TBA

# Topic #2: [11.2] RAN4 specification impact and UE implementation impact for a UE configured with two serving cells, each with SUL

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Proposals / Observations/Abstracts** | **Company** |
| R4-2307148 | **Observation 1:** The NR CA band combinations with two SUL cells in Rel-18 is a RAN4 spectrum related WI, which follows the usual study methodology for band combinations to specify the band combination specific requirements.  **Observation 2:** 0us switching is for 1 carrier->1 carrier switching with two-band pair involved. For both switching from or switching to, there is only 1 carrier on transmission. For such case, the 0us switching is doable for a band pair by the proper UE implementation and is not limited to band combinations with SUL.  **Observation 3:** 0us switching has no specific RAN4 switching requirements.  **Observation 4:** Switching period capability-based Tx switching involves Tx switching with simultaneous transmission on 2Tx chains at least for one switching state, either switching from or switching to, or both.  **Observation 5:** Switching period capability-based Tx switching has time mask specified for both inter-band CA and SUL from Rel-16.  **Observation 6:** 0us switching between two SUL carriers and SUL carrier with non-corresponding NUL carrier for back-to-back transmission can be supported with proper UE implementation.  **Observation 7:** 0us switching between two SUL carriers and SUL carrier with non-corresponding NUL carrier for back-to-back transmission has no RAN4 spec impact.  **Observation 8:** Switching period based Tx switching is an advanced switching feature, which covers 1T->2T, 2T->2T and 3/4 bands switching. No specific implementation effort is needed for UE supporting two SUL carriers and SUL carrier with non-corresponding NUL carrier compared to inter-band CA in terms of same Tx switching framework.  **Observation 9:** The time mask requirements in the endorsed CR can already cover the cases mentioned in the RAN task, and no additional specification impact is foreseen to support a UE configured with two serving cells, each with SUL.  **Observation 10:** Tx switching frame work, i.e. switching period based solution, is also applicable for newly proposed UL configurations with simultaneous transmission on two bands.  **Proposal 1:** New UL configurations with two SUL bands and SUL band with non-corresponding NUL band should be added in a revised WID for two SUL cells.  **Proposal 2:** It is proposed to conclude in RAN4 that from both implementation and spec impact perspective, with completion of CRs for two SUL cells band combinations and Tx switching for 3/4 bands, there is no additional work needed to support a UE configured with two serving cells, each with SUL. | Huawei, HiSilicon |
| R4-2307258 | **Proposal 1:** Under Rel-18 Tx switching framework, for switchedUL between {SUL1, SUL2}, {SUL1, NUL2} and {SUL2, NUL1}, dynamic switching between different uplink configurations is supported and up to 2Tx chains at UE are needed, and so no UE implementation issue is observed.  **Proposal 2:** Under Rel-18 Tx switching framework, for switchedUL between {SUL1, SUL2}, {SUL1, NUL2} and {SUL2, NUL1}, no additional RAN4 specification impact is observed.  **Proposal 3:** For back-to-back transmissions between two SUL carriers and between SUL carrier and non-corresponding NUL carrier,   * Based on the UL configurations already included in the basket WI, new UE implementation is needed to support back-to-back transmissions without any switching period. * If three more UL CA configurations (in red below) can be added in RAN4 specification, no UE implementation issue is observed.  | **SUL band combination with CA** | **Uplink CA**  **configuration or SUL configuration** | | --- | --- | | CA\_n41A-n95A\_n79A-n98A | SUL\_n41A-n95A  SUL\_n79A-n98A  CA\_n41A-n79A  CA\_n41A-n98A  CA\_n95A-n79A  CA\_n95A-n98A |   **Proposal 4:** For back-to-back transmissions between two SUL carriers and between SUL carrier and non-corresponding NUL carrier, add three UL CA configurations for each of the 2-SUL cell configurations, to avoid new UE implementation and achieve more flexible spectrum usage. | China Telecom |
| R4-2307587 | **Proposal 1:** No UE implementation impact is observed to support the UL Tx switching for CA band combination with two SUL cells.  **Proposal 2:** Existing RAN4 requirements (i.e., time mask for switching across three or four uplink bands) can support the UL Tx switching for CA band combination with two SUL cells. No RAN4 specification impact is observed.  **Proposal 3:** No UE implementation impact is observed to support back-to-back transmissions between two SUL carriers and back-to-back transmissions between SUL carrier and non-corresponding NUL carrier without any switching period。  **Proposal 4:** No RAN4 specification impacts are observed to support back-to-back transmissions between two SUL carriers and back-to-back transmissions between SUL carrier and non-corresponding NUL carrier without any switching period. | CMCC |

## Open issues summary

Sub-topic description: RAN #99 task to RAN4

* *Task RAN4 to assess the additional, if any, RAN4 specification impact and UE implementation impact for a UE configured with two serving cells, each with SUL; report to RAN#100 with the goal of striving for potential normative work supporting the case where a UE is configured with two serving cells, each with SUL*
  + *E.g., whether back-to-back transmissions between two SUL carriers and back-to-back transmissions between SUL carrier and non-corresponding NUL carrier could be supported without any switching period, or*
  + *E.g., whether it is only feasible to support such configuration in the UL Tx switching framework with UE capability based switching period*
  + *Example band combinations are referred to in RP-223553 (RP-230719)*
  + *Further check the status in RAN#100*

### Sub-topic 2-1 assess specification and UE implementation impacts to support back-to-back transmissions between two SUL carriers and between SUL carrier and non-corresponding NUL carrier under the UL Tx switching framework.

**Issue 2-1-1: UE implementation impacts**

* Proposals
  + Option 1: No UE implementation issue.
* Recommended WF
  + Option 1.

**Issue 2-1-2: RAN4 specification impacts**

* Proposals
  + Option 1: No RAN4 specification impacts under Rel-18 UL Tx switching framework is observed.
* Recommended WF
  + Option 1

### Sub-topic 2-2 assess specification and UE implementation impacts for back-to-back transmissions between two SUL carriers and between SUL carrier and non-corresponding NUL carrier with 0us switching period.

**Issue 2-2-1: UE implementation impacts**

* Proposals
  + Option 1: New UE implementation is needed to support back-to-back transmissions without any switching period.
  + Option 2: No UE implementation issue.
* Recommended WF
  + Option 2

**Issue 2-2-2: RAN4 specification impacts**

* Proposals
  + Option 1: No RAN4 specification impacts.
  + Option 2: No RAN4 specification impacts except of band combination configurations.
* Recommended WF
  + Option 2